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ADVISORY COMMITTEE ON MARINE RESOURCES RESEARCH

Rome, 16-21 January 1967

REPORT OF ACMRR WORKING PARTY ON FISHERMEN'S CHARTS AND UTILIZATION OF SYNOPTIC DATA

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1967

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Rome, August 1967

PREPARATION OF THIS REPORT

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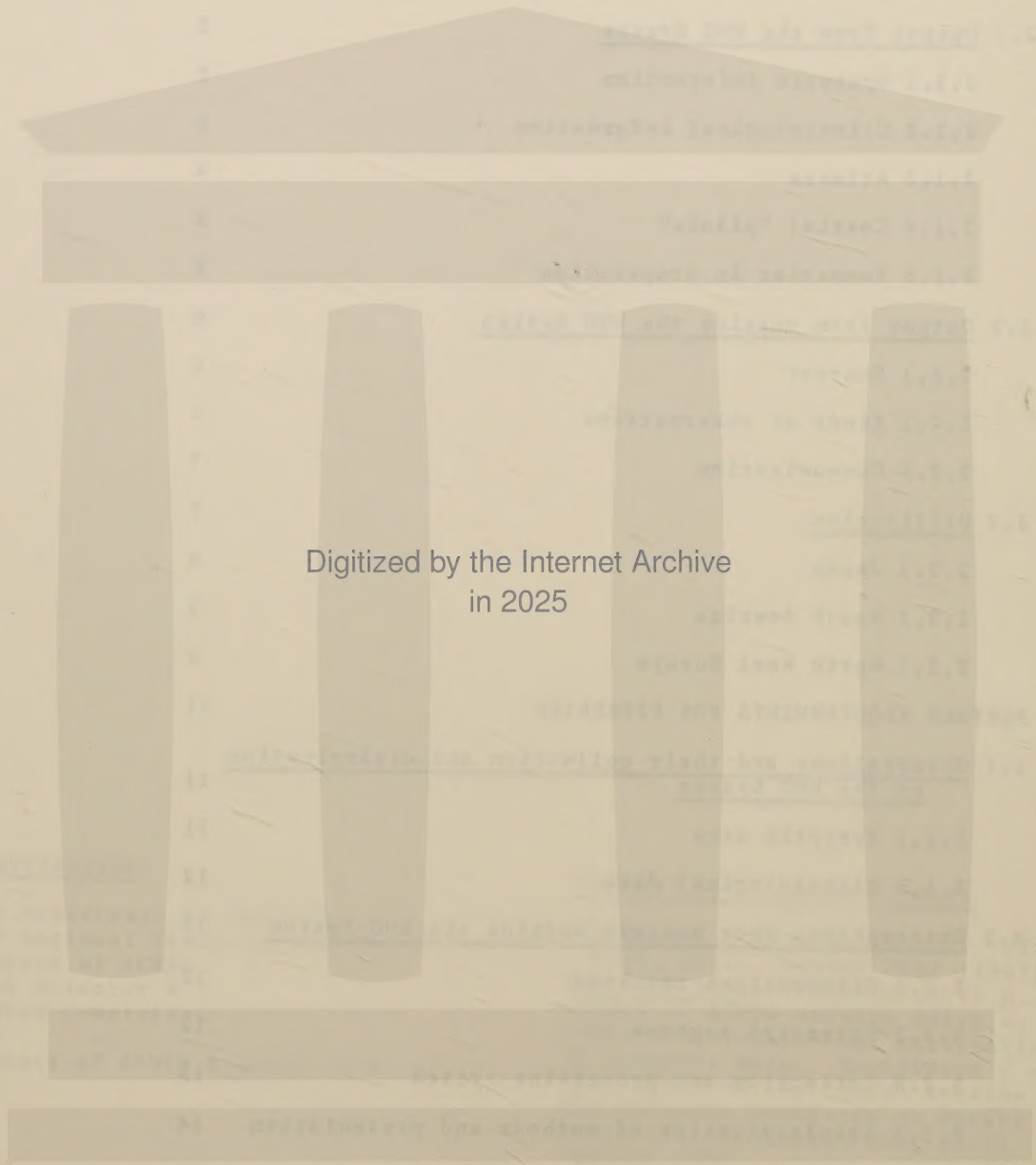

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1. INTRODUCTION

The FAO Advisory Committee on Marine Resources Research (ACMRR) at its second session held in Rome, Italy, February 6-12, 1964, established a Working Party on Fishermen's Charts and Utilization of Synoptic Data.

ACMRR noted that there is a need for average and synoptic information on oceanographic and marine meteorological conditions encompassing important areas of the world ocean. It stated that such information is necessary for planning fishing operations and ocean research and that it would have practical application in expanding world fisheries.

The task of the Working Party is defined in Recommendation 6 (ACMRR/2/Rec.6, February 1964), as follows:

(i) Examine what information is now available and is now in a properly usable form;

(ii) Study where the need is greatest for such maps and summaries;

(iii) Report to the next session of the Committee on how this information could be compiled and presented in adequate form.

The Working Party was formed in late 1964. Its membership was: Mr. G.V. Howard, Convenor, U.S.A.; Dr. J. Eggvin, Norway; Mr. J.W. Ramster, United Kingdom; Prof. M. Uda, Japan; Mr. G. Verploegh, WMO; Dr. G. Hempel, IOC UNESCO.

Dr. K. Terada, until he left FAO in April 1966, collaborated actively with the group; cooperation was also received from Mr. M. Bradbury who was the former representative of WMO to the Working Party.

Establishment of the Working Party stems from a growing realization of the need of fishermen and fishery oceanographers for average and synoptic marine meteorological, oceanographic and other information for fishery activities. Fluctuations in availability and abundance of fish population due to variations in the environment cause problems for scientists in determining the sustainable harvest and are responsible for much time wasted by fishermen in searching for fish, and can even cause the complete failure of a fishery.

Experience in certain regions of the world has already demonstrated that average and synoptic environmental information is useful to fishermen in planning and conducting their operations and to fishery researchers in determining estimates of levels of sustainable harvest. For instance, storm warnings and synoptic information on wave height and weather conditions, can help fishermen in the logistics and safety of their operations. Synoptic information on sea surface and subsurface temperatures, mixed layer depth, salinity and the like can assist them in locating concentrations of fish and eventually make possible predictions of availability and abundance.

So far, scientific work of the effect of variations in the environment on the abundance and availability have been largely confined to the study of isolated examples of long-term records. Soon, however, scientists will be ready to use "synoptic" observations more widely for such studies.

The Working Party expresses its full agreement with and endorses the efforts of other groups and individuals, such as ICES, who have voiced the need for more and better synoptic environmental data, catch and effort data, and other information for the further development and rational utilization of world fisheries.

An inventory (Appendix 1) of existing synoptic oceanographic and meteorological charts was assembled by the Working Party through correspondence during 1965. The Working Party met at FAO Headquarters in Rome, 19-23 September 1966, (with the presence of all the members, except Dr. G. Hempel), to conduct the remainder of its task and to prepare a first draft of its report. The report[1/] was completed in mid-November and despatched to the Secretary, ACMRR. Dr. I. Yamanaka of FAO prepared the final version of the Appendices to the report.

The session was opened by Dr. S.J. Holt, Director of the FAO Fishery Resources and Exploitation Division. Dr. M. Ruivo (Secretary of ACMRR) and Dr. I. Yamanaka of the FAO staff also participated in the session.

2. REVIEW OF INFORMATION AVAILABLE AND ITS UTILIZATION

The available environmental information which presently can be used by fishermen and fishery oceanographers originates from the world-wide WMO System (reports from ships at sea) and a few, variously organized, regional arrangements which enlist cooperating research, fishing and merchant vessels. Meteorological and sea surface temperature observations are collected by the WMO System and result in various synoptic reports and climatological atlases and summaries. The regional arrangements are designed to obtain specific oceanographic and fishery observations, certain of which are obtained in a synoptic or near-synoptic fashion. Resulting products (charts and advisories) are not synoptic in the meteorological sense. The regional arrangements are limited in number and in geographic extent. They are found off Japan, West Europe and the U.S. west coast but not elsewhere yet as far as can be determined. Although the WMO System operates world-wide, observations result in sufficient quantity only from the regions where there are well-travelled shipping routes.

Summarized below are the kinds of environmental data collected, and resulting products and their utilization by fishery researchers and fishermen.

2.1 Output from the WMO System

2.1.1 Synoptic Information

The following meteorological information is available to fishermen for logistics and safe conduct of fishing operations. The reports result from data collected at sea by vessels cooperating in the WMO System. Some regions of the world receive better coverage than others because of the distribution of shipping and of communication problems.

The information comprises observations made at a standard synoptic hour and collected, processed, analysed and made available to users within three to six hours. For high seas and coastal regions, the following products are regularly issued by meteorological centres, although as already suggested some ocean areas, especially the southern hemisphere, are poorly serviced because of lack of observations or problems of communication aboard fishing vessels:

1/ In accordance with the recommendation (ACMRR/4/Rec. 5.3) approved at the Fourth Session of ACMRR (January 1967), the Working Party was requested, as a matter of urgency, to study World Weather Watch Planning Report No. 15 and in particular to examine the adequacy of the products contained in Table 2 from the point of view of fishing operations.

The comments, received in March 1967 from Dr. G.V. Howard, Convenor of the Working Party were transmitted to WMO.

Products	Details	Analysis of Present Conditions	Short-Range Forecast
Storm warnings	Location and movement of pressure systems, gale force and high winds, including tropical storms and hurricanes and other such hazards.	X	X
Marine weather analysis	Fronts, pressure centres and isobars, selected ocean station and moving ship observations, including reports of wind, weather visibility, air temperature.	X	
Marine weather forecast	Expected positions of fronts and pressure centres at specific time intervals. Also prognostic charts depicting these positions and showing isobars to indicate intensity and centres. Forecast data concerning wind, air temperature, visibility and weather.		X
Sea ice	Description of areas of ice identifying locations where ice is impassable or requires icebreaker assistance.	X	X
Specialized warnings	Significant changes in wind weather conditions, abnormal tidal conditions, or heavy breakers and surf.	X	X

Notes: (i) Short-range forecast refers to periods up to 24 hours.

(ii) The detail of these forecasts varies depending on whether the information is required for activities on the high seas or in coastal areas.

(iii) The above products are disseminated by facsimile and in coded and plain language messages.

(iv) "X" - indicates product available.

For the North Atlantic and North Pacific Oceans the following information is also given by a number of meteorological centres.

Products	Details	Analysis of Present Conditions	Forecast	
			Short-Range	Medium
Wave analysis	Pattern of wave heights, direction and sometimes period.	X		
Wave forecast	Prognostic charts depicting forecast wave patterns.		X	
Ship routing advisories	Recommendation of favourable routes for the ship as far as expected weather and wave conditions; on request.		X	X
Superstructure icing	Areas of probable superstructure icing due to freezing rain or seaspray; incidental.	X	X	

Notes: (i) Medium range forecast refers to periods up to 72 hours.

(ii) Wave analyses and wave forecast are broadcast by means of facsimile, but can be made available in coded or plain language messages on request.

(iii) "X" - indicates product available.

2.1.2 Climatological Information

There is a wealth of historical climatological information (including sea/surface temperature) for many regions of the world ocean. The ocean areas which are well covered, however, are those for which sufficient observations are available from merchant shipping over the past hundred years. A paucity of observations exist for large areas of the Pacific, Arctic and Antarctic. Much of the accumulated information is incorporated in atlases and summaries described below. Under WMO sponsorship new summaries are being prepared. Additionally, it is possible to obtain available historical observations in machine read-outs, in desired form, from appropriate national meteorological depositories.

2.1.3 Atlases

Climatological data on air pressure, wind, air and sea-surface temperature, visibility, cloudiness, precipitation frequency, ocean surface currents, wind waves and swell are available in the form of monthly means over a large number of years from marine climatological atlases which have been prepared by various maritime meteorological institutes between 1880 and 1960. Some of these atlasea also show computed one-degree square means.

Details of the frequency distribution of the particular element concerned are also often given, e.g. wind roses and current roses, and sometimes standard deviations (or quartile percentages) of pressure and temperature.

For some ocean areas - the waters surrounding Japan, the North Sea and Eastern North Atlantic Ocean, the eastern part of the North Pacific Ocean - monthly mean sea surface temperatures for individual years, covering varying periods of time, have been published. Similar means have been published for a number of selected squares on the shipping lane from Western Europe to South America (period 1913-1939). These publications will be taken into account in the conduct of the WMO Project described in a succeeding paragraph.

2.1.4 Coastal "pilots"

"Pilots" for shipping in coastal areas invariably include a description of local weather, current and tidal conditions. The information is based on climatological data from coastal stations, light vessels and moving ships. Climatological tables of mean pressure, wind and air temperature data are often included for a number of selected coastal stations.

2.1.5 Summaries in preparation

In Resolution 35 (WMO Congress IV, 1963) a new international scheme for marine climatological summaries was initiated. The oceans are divided into nine "responsible" areas. For each area, a maritime meteorological centre (national centre of a WMO Member) is responsible for the processing of meteorological observations from all ships which ply the particular ocean area and contribute to the WMO system. Data will be processed on a regular basis for a restricted number of selected small squares (one to five degree squares, where the density of shipping is greatest). The summaries will consist of tables showing monthly frequency distributions of the meteorological elements and sea surface temperatures which are observed, together with the corresponding monthly means. The summaries will be published each year, probably about one year after the closure of the observing period. The new scheme starts with observations over 1964; the first summaries are not yet published. It is intended also to work back to 1960, and for a restricted number of elements, including sea surface temperature, to 1950. Address of the centres which are responsible for the preparation of the summaries are available from WMO.

In 1966 the Executive Committee of WMO approved a plan which was initially raised within WMO and which aims to bring historical sea surface temperature data up-to-date. Monthly means will be prepared for individual years, from 1860 to 1960, of sea surface temperature, air temperature, wind scalor speed and mean vector wind velocity for selected "representative" squares in all oceans where sufficient data are available. These data will be published in the form in World Marine Records. Dimension of the squares selected depends on the availability of ship observations and on the varying nature of oceanic areas. The scientific requirements for such needs are being explored by the Secretary General of WMO.

2.2 Output from outside the WMO System

As previously noted, there are a few regional arrangements, variously organized and operated, to obtain, analyse and disseminate environmental and other information to fishermen in a form which will assist them to improve their fishing efficiency. The environmental information collected is dominately oceanographic (the WMO System is largely meteorologically oriented). Also collected are observations in distribution and size of catch. The information is also used by fishery oceanographers in their ecological studies.

The few regional arrangements are operated by fishery laboratories or groups of laboratories, and are primarily national as yet. The kind of information collected, the types of charts and kinds of advisories prepared therefrom and the utilization of the data by fishermen and researchers varies with geography and the species of fish concerned. Information from the WMO System is incorporated to some extent or is a dominant input depending on the operation. Time periods over which the information is collected and disseminated vary. Charts and advisories may be issued monthly or for some lesser period.

2.2.1 Sources

Oceanographic data, though limited with respect to kinds of observations, are being passed on a routine basis to fishery laboratories in several regions of the northern hemisphere. The observations originate from cooperating merchant vessels (in and outside the WMO scheme), research and training vessels, lightships, fixed oceanographic stations (towers and other platforms, offshore reference stations, shore stations, and the like), and fishing craft. No known centres exist in the southern hemisphere, where data are being collected with a view to presentation of near-synoptic charts for fishery purposes. However, the IOC has under permanent review and is promoting an oceanographic data exchange system connected with the two World Data Centres, WDC-A, Washington, D.C., U.S.A. and WDC-B, Moscow, U.S.S.R., which receive, process, store and disseminate data of the declared national programs in oceanography collected by research vessels and some fixed stations. This data exchange system is directed towards the world-wide use of data for oceanographic research. At present, the system does not provide for the rapid compilation and immediate dissemination of synoptic data similar to the exchange of weather observations.

There is no system of routine data exchange among fishery laboratories which compares with that worked out for the national meteorological centres under WMO auspices. The few existing data-accumulation systems are organized in fact to throw light on the problems of particular fisheries within relatively small geographic areas. The extent to which the various sources of data are used varies from region to region. In Japanese home waters, for example, the reports coming from fishing, research and training vessels alone arrive in such volume that charts are prepared with the exclusive use of such data. In the ICES area, on the other hand, the charts of the Pilot project of 1966 (see below) and of an earlier scheme were based mainly on data collected by research vessels, lightships, weather ships, and cooperating merchant ships. The data collected along the west coast of America, other than sea surface temperature data received from the WMO System, comes from selected vessels of several types. In all three areas there is collection of data from fixed oceanographic stations for use in coastal or estuarine fisheries.

2.2.2 Kinds of observations

The kinds of near-synoptic oceanographic observations presently collected by the regional laboratories are of two types. The first type includes observations which are easy to observe from ships of opportunity; the second includes those for which the need is so marked that the laboratories concerned make certain that the relevant instrumentation is on board the data-collecting ships and is properly maintained.

Sea-surface temperature observations, catch data and the like, fall in the first category. Those in the second category vary from region to region depending on the special needs of the researchers and the relationships discovered between specific environmental parameters and the distribution and abundance of particular commercial species of fish.

For example, Japanese laboratories arrange for some tuna longline vessels to report sea temperature to a depth of 200 meters and current speed and direction (determined from drift of gear), whereas salmon gillnetters also report sea colour and water transparency. In European waters, data-collecting merchant vessels are equipped to measure surface salinity and some tow Hardy plankton indicators.

In addition to the kinds of observations it is possible or feasible (due to instrumentation limitations) to obtain from ships of opportunity, the various regional collecting systems depend on near-synoptic observations from research vessels. As yet, it is not common to obtain and process on a near-synoptic basis, much more than sea temperature (surface and sub-surface), salinity, and current measurements.

2.2.3 Communication

Laboratories in Japan and the United States which are engaged in the preparation of charts and advisories for fishermen depend, for the most part, on radio communication to obtain required observations. Dissemination of the material to fishermen is primarily by radio and facsimile in Japan; in the United States mail and radio are used. In both regions the information is obtained and disseminated in a near-synoptic fashion. The early ICES charts,and charts produced by the European countries, except for the Pilot project of 1966 and some earlier experiments, have been produced some months after the environmental observations were collected. Under such circumstances the products are of more value to researchers than fishermen. IOC, through its Working Group on Communications, is trying to improve the world communication system by obtaining radio frequencies for telemetering oceanographic data.

2.3 Utilization

Synoptic advisories (listed on page 3) which result from the WMO System and are issued or broadcast by national meteorological centres are utilized by fishermen to improve their logistics and for purposes of safety. The information is more widely utilized by fishermen of the north Atlantic, North Sea and certain areas of the north Pacific than elsewhere in the world because observational coverage and services are superior in these regions. Observational coverage in the remainder of

the world, especially over the vast equatorial region and the southern hemisphere, is inadequate. In addition, radio reports are difficult to receive, except by vessels with superior equipment, over the great distances to the few national meteorological centres which are operated in the southern hemisphere.

Utilization of "synoptic" environmental information obtained by the WMO System and oceanographic information collected by other means for fishery research, for the improvement of fishing efficiency, and the further development of world fisheries is a relatively new endeavour. It first began in Japan some 15 to 20 years ago and spread more recently to parts of North America and North West European countries. It is only a matter of time before it is adopted in other regions. A description follows of the environmental collecting and reporting systems in effect in the three regions[1/]. An inventory of the majority of the environmental charts which result appears in Appendix I.

2.3.1 Japan

A large-scale project to forecast fishing and oceanographic conditions in the Japanese waters has been in effect for many years. Since July 1965 the system has been strengthened and coordinated nationally. It utilizes radio-communication, facsimile and printed material. Over 600 fishing vessels are equipped with facsimile sets to receive reports. Six Regional Fisheries Research Laboratories of the Japanese Fisheries Agency, and 38 Prefectural Fisheries Experimental Stations collect, analyse and disseminate the information. Selected fishing boats have been recruited to report oceanographic and fishing conditions. On the average, reports are received each month from 150 vessels. These vessels augment information collected from research vessels which make regular monthly surveys. At the present time no input is received from the WMO System except that sea temperature charts issued by the Japan meteorology agency do incorporate observations from that source. (Details of the program are outlined in Appendix 2.)

So far, the system is applied primarily for the fisheries in the adjacent waters of Japan and not for the distant-water longline tuna fisheries. For the latter, more than 50 prefectural research and fisheries training boats, supply synoptic bathythermograms (some of them using reversing thermometer records) together with the experimental fishing and biological data. Such reports come from the Pacific, Indian and Atlantic Oceans, but coverage is sparse. Consideration is being given to the use of the WMO System to supplement sea surface temperature data. Tokai University (Shimizu City) is receiving the hydrographic, fisheries and biological data (fish school distribution, etc.) from the tuna longline fishing boats. It is broadcasting by facsimile results of the analyses on an experimental basis.

2.3.2 North America

Ocean information reporting in North America at present is primarily for research and defense purposes. Little activity is specifically directed to fishery applications. For the Pacific

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1/ Dr. M. Edelman, Fisheries Oceanographer, VNIRO, Moscow, contributed a note after the session on the use of synoptic observation for fishery research and fishing operations in USSR. (See Appendix 3)

Ocean three groups are engaged in reporting ocean environmental observations. Bureau of Commercial Fisheries Tuna Resources Laboratory (TRL), La Jolla, California; Canadian Oceanographic Information Center (COIC), Esquimalt, B.C.; and U.S. Navy Fleet Numerical Weather Facility (FNWF), Monterey, California. FNWF is concerned with oceanographic and meteorological observations from the entire northern hemisphere. The U.S. Navy Oceanographic Office (NAVOCEANO) is concerned with the Atlantic Ocean. Pertinent charts of these laboratories are listed in Appendix I.

The TRL is the only active ocean information reporting group directly providing synoptic environmental information to fishermen. Besides sea surface temperature charts, TRL provides daily radio advisories on albacore fishing conditions (based on weather reports, catch reports, data from research vessels and FNWF charts). Annual albacore forecasts are also prepared and issued.

Although all the environmental charts referred to are available to fishery oceanographers for research purposes, only sea surface temperature charts issued by TRL are specifically prepared as fishermen's charts.

The main source of observations for the sea surface temperature and meteorological charts, produced in North America, is the synoptic marine weather reports from the WMO collection system. The laboratories have "drop lines" on the WMO teletype circuit to receive the reports from ships at sea.

Thermocline charts are prepared from the few available observations made by research vessels, navy vessels and a few cooperating high seas tuna vessels, but are not available to fishermen.

The monthly sea surface temperature charts of the northwest Atlantic prepared by NAVOCEANO have utility for some fishermen and may be received by facsimile. Distribution of TRL charts is by mail and, therefore, the method is only partly satisfactory. Coded messages of the 15-day chart are broadcast by radio to albacore fishermen at sea. Most albacore fishermen subscribe to the sea temperature charts because the distribution of albacore tuna is directly related to sea surface temperature and they find that the charts improve fishing efficiency. The sea surface temperature charts are only moderately useful to tropical tuna fishermen at the northern and southern extreme of the fishery. Charts of mixed layer depth would be useful but insufficient BT observations presently preclude their preparation.

Except off the immediate coasts of the United States and Canada, weather forecasts and storm warnings are unavailable to fishermen because of few observations and poor radio communication, largely the result of unsatisfactory equipment aboard fishing vessels.

2.3.3 North West Europe

Presently the only synoptic oceanographic chart produced in Europe is the 10-day ice chart issued by the British Meteorological Office. It shows the various types and concentrations of ice covering the sea area of most of the northern hemisphere and surface isotherms for the north Atlantic and adjacent seas. The sea-surface temperature data are obtained from synoptic reports of "selected" merchant ships, trawlers, ocean weather ships and research vessels. Four values a day over ten days are used to produce 10-day means for each one-degree square and from these the isotherms are drawn. Charts are distributed by mail about four

days after the end of each 10-day observation period. A more accurate, coloured edition of the third chart of each month follows in two to three months. The maps are available to interested scientific, nautical or fishing interests.

Since January 1966 a daily radio facsimile broadcast of up-to-date temperature and ice conditions for prescribed areas has been made, the complete area being covered by putting together any three consecutive broadcasts. At the request of British Trawler owners profiles, (when available) of BT casts made from research ships sailing near fishing grounds are incorporated in the facsimile ice charts. Monthly summaries of Atlantic weathership bathythermograph observations are given in diagrametic form on the back of the coloured ice map.

There are no synoptic oceanographic charts specifically prepared for, or used by, the European fishermen or fishery research workers. During the period 1950-58, however, ICES produced monthly charts of surface temperatures, salinities and currents, as well as 10-day mean winds and notes discussing various features of the charts. These maps appeared from 3-15 months after the month in which the observations were made. The series was discontinued in 1958. In 1953 La Centre de Recherches et d'Etudes Oceanographiques (Paris), began circulating monthly charts of surface isotherms for the sea area between Casablanca and the Straits of Dover, but they were discontinued in 1956.

At the ICES meeting in Copenhagen 1-10 October 1959, the problems of collaboration between different countries in synoptic oceanography and its application to fisheries was discussed. A sub-committee was appointed by the Hydrographical Committee to consider the problem.

The main task of the sub-committee was to discuss the needs, possibilities and possible gains and costs involved in the application of synoptic oceanography to fisheries and to formulate a plan for international collaboration (ICES C.M. 1960). An oceanographic telecommunication code was prepared and, to gain experience, small projects on synoptic oceanographical forecasts were conducted, based on Danish and Norwegian material.

In accordance with a resolution passed by the ICES in October 1965, a pilot project was carried out January-March 1966 covering the region of the North Sea, the Skagerack and Kattegat, parts of the Norwegian Sea and the Barents Sea, and the north-eastern part of the North Atlantic to 25° West. The Fisheries Directorate, Marine Research Institute, Bergen, ran the project. Information originated from research ships, light ships, weather ships, fixed oceanographic stations, from merchant ships with sea surface thermographs and with facilities for surface salinity sampling. In addition, surface temperatures taken on board WMO "selected ships" were received through meteorological institutes. In all, eight[1/] countries participated. Ten-day charts of surface temperature with anomalies were issued and when material was available information on sub-surface temperature, salinity distributions, current and temperature sections was also included. The charts were transmitted to fishermen by facsimile after (1 to 3 days) the end of each 10-day period. Copies of the

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1/ Denmark, Germany, Iceland, Netherlands, Norway, Soviet Union, Sweden and United Kingdom.

charts, together with interpretation relative to the oceanographic conditions and the fisheries, were distributed by mail to all interested parties. Favourable comments on the usefulness of the charts were received from fishery, oceanographic and meteorological institutions and fishermen.

3. FURTHER REQUIREMENTS FOR FISHERIES

The Working Party was instructed, after examining the kinds of environmental and other observations available to fishermen and fishery oceanographers, to "study where the need is greatest for such maps and summaries." It decided, however, that it would be difficult, if not impossible, to name regions and fisheries because the requirements for information and its application will vary with geography. It seemed preferable, therefore, to outline where improvements might be made in the WMO System, with respect to information which fishermen require for logistics and safety, to point out the need for basic oceanographic observations on a synoptic or near synoptic basis and to emphasize the need for a communication system to obtain the observations.

3.1 Observations and their Collection and Dissemination by the WMO System

3.1.1 Synoptic Data

The Working Party noted the plans which are being developed in WMO, under the system of World Weather Watch, to improve the services rendered by meteorological offices to shipping in general and fishing operations, in particular, not only for safety aspects but also from economic purposes. As regards to safety, it endorsed the WMO plan to provide an explicit indication of the wind pattern over ocean areas and a greater detail in the delineation in space and time of wind forecasts. It also endorsed the plan to give specific information on the height, period and direction of wave systems in all fishing grounds, to be issued to fishing vessels on a regular basis and in a form which can easily be interpreted by fishermen. The party also expressed support for regular forecasts of superstructure icing conditions.

There is room for improvement in surface forecasts, however. More forecasts of conditions over relatively small areas are needed. In many fishing regions local coastal weather often differs considerably from that on land and that farther offshore. At present, little attention is paid by most weather services to the specific requirements of different fishing fleets.

As regards economic aspects, namely information for improving fishing efficiency, the sea surface temperature is the only element in the present WMO System which will be of concern. For required near-synoptic analyses of sea surface temperature and the anomalies, many more observations are needed than are available now. The Working Party considered that it is important to obtain more observations from the so-called "sparse areas." It would seem possible to request supplementary and auxilliary ships to measure and report sea surface temperature. Such ships do not presently report sea surface temperature. Also, fishing vessels could contribute more observations than they now do. More effort must be given to enlisting fishing vessels in the WMO System. Two means of gaining the cooperation of more fishermen are to improve the communications problem which they experience in many regions and to demonstrate that resulting services and charts provide information which is useful for fishing purposes.

Beyond the need for more observations and more cooperating vessels for the WMO System, both of which should result under the World Weather Watch, there is the great need to obtain more observations

from the regions of sparse coverage (regions outside well-traversed shipping lanes). Weather satellites will eventually contribute certain observations but unmanned instrumented buoy networks will also be essential. It appears that buoy networks are not being emphasized sufficiently.

3.1.2 Climatological data

Interpretation of environmental fluctuations in relation to variations in the abundance and distribution of commercial fishes requires long-term records of climatological data and fishery catch and effort statistics. For some parts of the world and for some fisheries, no such historical records exist or they are sufficiently sparse as not to be useful. It is important that summaries be prepared for the information which does exist and that, in the future, efforts be made to collect such information worldwide on a continuing basis.

Long-term records of sea surface temperature are needed for the computation of anomalies. Interpretation of local anomalies is not possible without information on the long-term variations of the sea surface temperature in the area and on the characteristics of the frequency distributions from which the temperature means were computed. In this connection, information which results from the WMO Project of Historical Sea Surface Temperature Data should be particularly useful to fisheries. It is hoped that in those ocean areas where sufficient data are available dense coverage of squares will result from the Project, for this information will enable detailed studies of their anomalies and correlation with fish concentrations.

3.2 Observations from Sources Outside the WMO System

3.2.1 Observations required

As noted previously, the kinds of synoptic and near synoptic observations required by fishermen and fishery researchers will vary from region to region and by the type of fisheries. Similarly the types of oceanographic observations which it is possible to make from ships varies. Ships of opportunity (merchant vessels and fishing craft for example) are more limited than weather ships, and weather ships are more restricted than research vessels. Nevertheless, rapid strides are being made in oceanographic instrumentation which are or will soon increase the observational capabilities of all categories of platforms which participate in programs to collect oceanographic data.

For these many reasons, the Working Party did not consider it worthwhile to attempt to list oceanographic observations which are or might be required by fishery interests, except to emphasize the need for more (and better geographic coverage) sea temperature (surface and sub-surface through the mixed layer) and surface salinity observations, both of which are required by all fisheries. Instrumentation has already been developed which makes possible such observations from all ships of opportunity and fixed platforms such as unmanned buoys.

3.2.2 Potential Sources

At the present time, and except for ships making sea surface temperature observations through the WMO System, sources of oceanographic observations for environmental summaries (synoptic or otherwise) are limited, especially for research and forecast requirements of fisheries. They include research vessels, a

few ships of opportunity enlisted by particular laboratories to make special observations, and miscellaneous other facilities such as shore stations and various fixed oceanographic or weather stations which also cooperate on an ad hoc basis.

Some of the oceanographic observations acquired from the sources described are obtained routinely over relatively wide geographic regions. It should be possible now, however, to cover some large ocean areas on a permanent basis with observations taken by research vessels and ships cooperating in the WMO System. Significant expansion of the utilization of ocean environmental summaries and forecasts for fishery or other purposes, nevertheless, awaits improvement in coverage and synopticity. The potential for improvement exists both for the short and long term. Sources of such environmental information and certain requirements for harnessing them are suggested:

a) Merchant and other vessels: Enlist merchant, naval, fishing and other craft to report standard oceanographic observations synoptically in a manner similar to the WMO System for reporting meteorological observations. Instrumentation is already available for sub-surface temperature (expendable bathythermograph) and surface salinity (recording salinometer). As instrumentation is developed means will be available for making observations of other properties. Requirements for the latter will vary from region to region depending on the fisheries concerned;

b) Research cruises: Besides the standard oceanographic observations noted in item 1, laboratories conducting oceanographic expeditions should be encouraged to process pertinent oceanographic observations at sea for radio transmission ashore. The types of information which are desired in "real" time will vary by region and fishery;

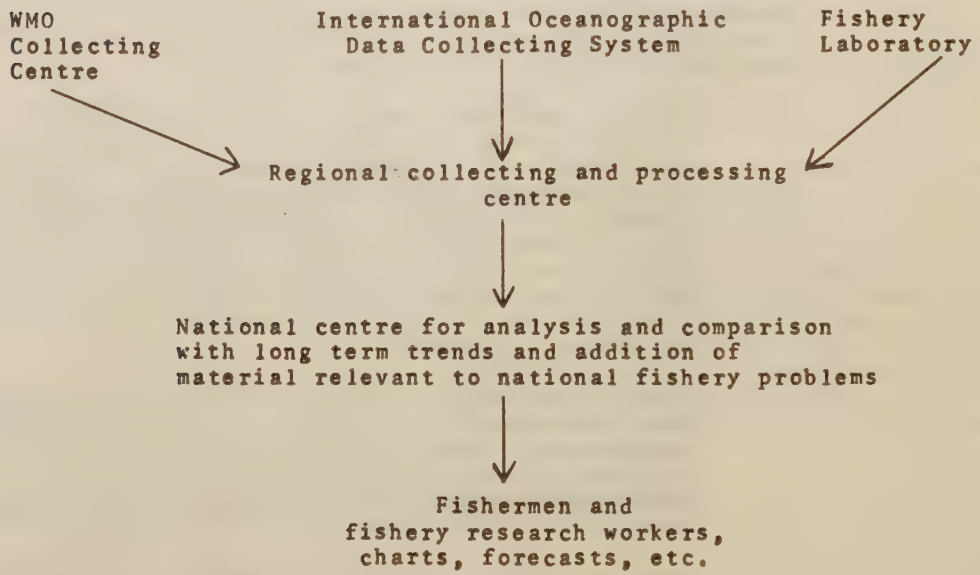
c) Unmanned buoys: As noted, unmanned instrumented oceanographic stations offer great potential for oceanography and meteorology. The value of unmanned buoy networks to fisheries are also immense and every effort should be made to see that the needs of fishery interests are considered and accommodated in the planning of such networks.

d) Satellites: Satellites, like unmanned buoys, have great potential for weather and oceanographic interests, including fisheries. Initially, their greatest value appears to be as relay stations for data collected at the sea surface and there is the possibility that their microscopic view may lead to the recognition and recording of oceanic fronts.

3.2.3 Collection and processing system

As has already been mentioned in 2.2.1, although these are two international depositories (World Data Center A, Washington, D.C., U.S.A. and World Data Center B, Moscow, U.S.S.R.) for oceanographic observations, no international system exists for the collection and dissemination of synoptic oceanographic and fishery observations, comparable to the WMO System for meteorological observations. Development of such a system is overdue.

Irrespective of the nature of the centre (fishery laboratory, oceanographic centre or meteorological centre), which issues charts, summaries or forecasts to fishermen, it must have easy and direct access to all oceanographic and other fishery-related data collected from the different sources in its region of interest. Fishery research as well as fishing operations would benefit a worldwide system, similar to that of WMO, for the collection and dissemination of oceanographic observations and from intercommunication with regional collecting stations operating within the overall system. The type of system envisaged is outlined schematically:


WMO Collecting Centre
International Oceanographic Data Collecting System
Fishery Laboratory
Regional collecting and processing centre
National centre for analysis and comparison with long term trends and addition of material relevant to national fishery problems
Fishermen and fishery research workers, charts, forecasts, etc.

3.2.4 Standardization of methods and presentation

Whereas the matter of instruments and methods employed for taking oceanographic observations is perhaps outside the terms of reference of the Working Party, it wished to bring attention to the need for the development of standard procedures for making oceanographic observations. The need for standard instruments and the development of such procedures is well-illustrated by problems presently encountered in analysing sea surface temperature observations from merchant shipping where ship's bias results from the lack of standard procedures.

An international code needs to be developed for the transmission of oceanographic observations. Additionally, regional codes will be required to handle special observations peculiar to limited ocean areas.

With respect to the presentation of oceanographic charts issued from regional centres, standard formats should be developed, so that they fit, as far as scale, projection, contour interval, symbolic representation, and the like, into a uniform global scheme. At the present time, there is no method of linking regional presentations of sea surface temperature.

4. RECOMMENDATIONS

Expanded utilization of environmental information for fishery purposes (weather information for logistics and safety, and meteorological and oceanographic observations for improving fishing efficiency, understanding variations in availability, and further development of world fisheries) needs to be stimulated. Towards that end, the Working Party made the following observations and recommendations to ACMRR:

a) With respect to observations collected, processed and disseminated through the WMO System, there are immediate needs:

   (i) At the present time, little attention is paid by most weather services to the specific requirements of fishing fleets. Improvement is needed in surface weather forecasts for fisheries for some regions of the world and the means of communicating to fishing vessels at sea;

   (ii) Many more meteorological and sea surface temperature observations are needed in both time and space than are now available. It is particularly important to obtain observations from the so-called "sparse areas". An effort should be made to have supplementary and auxiliary ships participating in the WMO System report sea surface temperature routinely. More effort should be given to enlisting fishing vessels in the WMO System;

   (iii) It is understood that the World Weather Watch will employ unmanned buoy (instrumented stations) networks. It is important to fishery interests that the capability of monitoring sub-surface observations be incorporated in the buoys;

   (iv) National centres are planning, as a result of action in 1966 by WMO, to bring historical sea surface temperature data up to date. The plan envisages monthly means for selected "representative" squares in all oceans. An effort should be made to expand the project to provide the information for all one-degree squares where sufficient data are available. Fishery interests have a need for monthly means of sea surface temperature over all ocean areas, both historical and current.

b) With respect to oceanographic observations for fishermen's charts, fishery research and other purposes:

   (i) Activities of IOC and the WDC's may be assisting in the development of an international system for the collection, processing and dissemination of oceanographic observations, comparable to the WMO System for meteorological observations, but no such system now exists. Influence should be brought to bear to promote its establishment. In the meantime, such efforts as have been undertaken by ICES should be encouraged regionally where there are sources of data;

   (ii) Concurrent with the establishment of a worldwide system for the collection, processing and dissemination of oceanographic observations there is a need to develop standard procedures for making observations, an international code for radio transmission of the observations, and standard formats for chart presentation. Appropriate bodies should be advised of these requirements;

(iii) Cognizance should be taken of recommendations made in the "Report on the Rapid Utilization of Synoptic Oceanographic Data, Fixed Stations and Biological Data Exchange" (ACMRR/2/WP.6, 5 Feb. 1964) concerning the requirements for rapid utilization of oceanographic data. In particular, the report states that environmental charts should be interpreted in terms understandable and useful to fishermen. It notes that the accuracy of such interpretations and of prediction based on charts will be as good as the understanding of the fish in response to changes in the ocean, therefore, much more research is required. The need for such research cannot be over-emphasized. More effort in this area must be stimulated.

(iv) The development of platforms which will be suitable for unmanned buoy networks is proceeding rapidly. More attention, however, needs to be given nationally and internationally to the development of automatic instrumentation for installation on unmanned buoys to obtain and relay oceanographic observations. Similarly, automatic instrumentation is required for installation on ships of opportunity. Means should be sought to stimulate attention in the area of instrumentation;

c) The application of oceanographic information (fishermen's charts, radio advisories and the like) for the improvement of fishing efficiency and the development of world fisheries is not widely in use outside Japan. FAO should consider the merits of preparing and publishing a description of the available fishermen's charts and their utilization to promote wider application in other regions of the world.

APPENDIX I (a)

HISTORICAL CHARTS

Japan

Wada, Y.	Bull.Cent.Met.Obs.Japan Temperature Moyenne Annuelle (1892-1901) de la Surface de la Mer dans l'Océan Pacifique Occidental.
Wada, Y. 1926	Oceanic Currents Atlas No. 1, 1904, based on drift bottle experiments.
Japan Hydr. Office	Currents Atlas (1926-1966)
The Kôbe Marine Observatory	The Marine Meteorological 30 years Report (averaged 1911-1940) 1943 (sea surface temperature averaged for 1° grid in the waters adjacent to Japan and averaged for 5° grid in the North Pacific). Annual Reports (monthly, 1911-1941) also published.
Uda, M. and G. Okamoto 1930, 1931	J.Fish.Exp.Sta.Tokyo, Vols. 1 and 2 On the monthly Oceanographical Charts in the adjacent seas of Japan averaged 1918-1929 (0^m 100^m Temperature and Salinity).
Uda, M. 1935	"Umi to Sora" Averaged seasonal (Feb., May, Aug., Nov.) maps of Transparency of Sea Water (Meter in Secchi's disc) and Colour of Sea (Florel's scale)
Masuzawa, J. et al 1962	Oceanogr.Mag. Vol. 13, No. 2 (Kôbe Marine Observatory) The monthly mean sea surface temperature in the North-West Pacific (data averaged for 1950-1959, 18°-46° N, 117°-165°E).
Naganuma, K 1964	Bull.Japan Sea Fish.Res.Lab. 13 (Data of average and standard deviation of 1953-1962, surface 50^m, and 200^m, in 30' rectangle.)

North Sea and North Atlantic

American Geographical Society

Pyle, Robert L. 1962	Sea Surface Temperature Regime in the Western North Atlantic, 1953-54 (Folio 1).
Laevastu, T.	Surface Water Types of the Northern Sea and their characteristics (Folio 4).
Bumpus, Dean F. and Louis M. Lanzier 1965	Surface Circulation on the Continental Shelf off Eastern North America between Newfoundland and Florida (Folio 7).
Fritz, Raymond L. 1965	The bottom isotherm was printed on a transparent sheet so that one is able to compare the distribution of temperature to that of bottom fishes. Autumn distribution of groundfish species in the Gulf of Maine and adjacent waters, 1955-61 (Folio 10).

Besides the above list, there are also biological, meteorological and chemical charts.

Atlantic Ocean

U.S. Dept. of Int., Bureau of Commercial Fisheries 1963
Inventory of Oceanographic Data for the Western North Atlantic Ocean and the Gulf of Mexico.
The number of Oceanographic Stations, monthly numbers of stations, number of BT observations, surface temperature observations, but no actual observed value was shown.

Fuglister 1960
Woods Hole Oceanographic Institution
The Atlantic Ocean Atlas of temperature and salinity - profiles and data from the IGY of 1957-1958.
Vertical Profile and BT data are shown, but no horizontal distribution was illustrated.

North Sea

Böhnecke, Günther und Günther Dietrich 1951
Deutches Hydrographisches Institut
Monatskarten der Oberflächentemperatur für die Nord- und Ostsee und die Angrenzenden Gewässer
(monthly chart for surface temperature)

Klimaj, A. and ST. Rutkowicz 1957
Morski Institut Rybacki - Gdynia
Atlas Rybacki Morza Polnocnego
(Fishing Atlas of the Northern Sea)

(1) Bottom shape, bottom sediment, mean surface temperature, tide, mean bottom temperature, mean salinity, herring and mackerel dislocation.

(2) Monthly mean operative indicators for trawler catches.

Hodgson, W.C. 1950
Conseil Permanent International pour l'Exploration de la Mer, Service Hydrographique
Fisheries of the North-East Atlantic. Herring Atlas.
(Fishing grounds, landing ports and quality.)

Lumby, J.R. and G. Kietrich 1962
Mean monthly temperature and salinity of the surface layers of the North Sea and adjacent waters from 1905 to 1954.

Atlantic, Eastern Pacific and Western Pacific

U.S. Navy, Hydrographic Office 1944
World Atlas of Sea Surface Temperature (Second Edition)
(monthly chart) in 5°F interval.

Pacific Ocean

U.S. Bureau of Commercial Fisheries 1962
Monthly Mean Charts, Sea Surface Temperature North Pacific Ocean.
Monthly charts from January 1956 to December 1957 and two years' mean monthly surface temperature.

European Waters

Deutsche Seewarte 1942
Atlas der Eisverhältnisse im Deutschen und Benachbarten Ost- und Nordsee-Gebiet.

Hydr. Section Fisheries Lab., Lowestoft 1955
Temperature and Salinity North Sea and adjacent Waters.

Seewetteramt, Hamburg	Klimatologie der N.W. Europäischen Gewässer Teil I und II (1954) Teill LLL (1956)
Deutsches Hydr. Inst., Hamburg 1951	Monatskarten der Oberflächentemp. für die Nord- und Ostsee und die angrenzenden Gewässer.
Seewetteramt, Hamburg	Klimatologie des Mittelmeeres Teil I: Windkarten (1961) Teil II: Temperatur, Bewölkung, Niederschlag, Nebel (1963).
Service Hydr. Danemark 1962	Mean Monthly Temperature and Salinity of the Surface Layer of the North Sea and adjacent Waters from 1905-1954.
American Geographical Socy. 1963	Serial Atlas of the Marine Environment Surface Water Types of the North Sea and their Characteristics, Folio 4.
Koninklijk Nederlands Meteorologisch Instituut 1957	The Mediterranean Atlas of Ocean. and Meteor. Data.

APPENDIX I (b)

SYNOPTIC CHARTS

North Atlantic

Area	Interval	Items	Office	History
North Sea Skagerack and Kattegat part of the Norwegian Sea, Barents Sea and NE part of the N. Atlantic to 25°W.	Ten days	Surface temp. with anomaly Subsurface temp. (salinity, currs., temps., sections when available)	Marine Research Institute, Bergen, Norway	Pilot stage Dec. 1965-Mar. 1966 According to the resolution of ICES Oct. 1965

NOTE: Origin of data:- Research ships, light ships, weather ships, five oceanographic stations, merchant ships (with sea surface thermographs and surface salinity samplings). Surface temperature by WMO selected ships.

Facsimile is used to transmit the data.

Japan

Area	Interval	Items	Office	History
Western Pacific Ocean	Ten days	Surface temp. anomaly, currents Surface salinity 100m temp. Coastal temp. General description.	Japan Meteorological Agency	Since 1950
East China Sea and Yellow Sea	Ten days	Surface temp., Coastal temp., Anomaly General Note	Nagasaki Marine Observatory	Since 1948
Kuroshio Area and other seas adj. to Japan	Monthly	Surface temp. and Sal. 100m depths Anomaly Fishing conditions	Tokai Reg. Fish. Research Lab.	1918-29 (Imp.Fish. Inst.) 1929-49 (Imp.Fish. Expt.St.) 1949-65
Waters east of Japan	Five days	Surface water temp. Fisheries (tunas, saury, etc.)	Tohoku Reg. Fish. Res. Lab.	1950-65
Japan Sea	Monthly	0, 50, 100m temp. Fishing conditions	Japan Sea Fish. Res. Lab.	1951-65

Area	Interval	Items	Office	History
Adj. Seas to Hokkaido	Monthly	Om and coastal temp.	Hokkaido Reg.Fish. Lab. and Fish. Expt. Station	1950
Seas adj. to Japan	Monthly	Surface temp. Fisheries (Pref.)	Local pref. Fish. Expt. St.	--
N. Western Pacific	Seasonal	Temp. (0-200m) Curr.	Japan Hydr. Office	1950
	Monthly	(speedy inf.)		(1939-43 Naval)
	"	(Surface Curr.)		1922-39
N. Pacific S. Pacific Indian Ocean	Ten days	Surface temp. Fisheries (tuna)	Tokai Univ. Fisheries Lab. (Shimizu City)	1961-65

Eastern Pacific

Surface Temperature Charts

Area	Interval	Items	Office	Data Source
1) North east Pacific E of 180°W N of 20°N	Monthly	Mean surface temp. Deviation from long term average Deviation from the proceeding year In 2°F interval	US BCF Tuna Resources Lab. La Jolla	Marine Synoptic Weather reports and Shore Station observations
2) Coast to 180° between 40°S and 20°N	Monthly	Not contoured Average temp. in F° shown in 1° x 1°		
3) Coast to 135°W between 25°N and 52°N	Semi-monthly between April & October	Surface temp. in 2°F No anomaly chart		
* 4) 50-60 mile strip along USA coast	Monthly	Surface temp. in 1°F	US Bureau of Sport Fisheries & Wildlife Tuburon Marine Laboratory Tuburon, Calif.	Single zigzag flights monthly with infra-red radiation thermometer
5) Coast to 160°W at 60°N and 140°W at 30°N	Weekly	Surface temp. in 2°F	Canadian Oceano-graphic Inform-ation Center Esquimalt, B.C.	Marine synoptic weather reports

* discontinued

Thermocline Charts

Area	Interval	Items	Office	Data Source
6) Coast to 160°W at 60°N and 140°W at 30°N	Weekly	Potential Layer Depth (top of thermocline) 20 ft. interval No anomaly chart	COIC	Navy vessels
7) "	"	Bottom of thermocline in 20 ft.	"	"
8) "	"	Magnitude of thermocline (temperature difference from top to bottom of thermocline)	"	"

Marine Synoptic Radio Weather Report Observations

9) Entire eastern Pacific and western Pacific north of Equator	Monthly	Surface temp. not contoured Number of observations and means by 5° x 5°	BCF-TRL	Marine synoptic weather reports

U.S. (other than Eastern Pacific)

Area	Interval	Items	Office	Data Source
1) Northern hemisphere	Daily for 3 day period	Surface temp. in 2°C No anomaly chart	U.S. Navy Fleet Numerical Weather Facility Monterey Calif.	Marine Synoptic weather reports and navy vessels
2) North-west Atlantic coast to 45°W between 10°N and 55°N	Monthly	Surface temp. in 2°F No anomaly chart	U.S. Naval Oceanographic Office Washington D.C.	"
3) "	"	Not contoured shows number of observations and mean temp. in C° in 5° x 5°	"	"
4) "	"	Thermocline charts top of thermocline in 50 ft. interval	"	"

APPENDIX II

Fisheries Oceanographical Forecasting Service, in Japan (tentatively prepared).

Program for the year 1966

I. Fishing Grounds:

The following 6 fishing grounds are concerned:

1. Sardines, Mackerels and Jack Mackerel fishing grounds off the North-East of Honshu.

2. Saury, Skipjack and Albacore fishing grounds off the East of Honshu.

3. Sardines, Jack Mackerel and Mackerel fishing grounds in the Japanese Sea.

4. Sardines, Jack Mackerel, and Mackerel fishing grounds off the South of Honshu, in the Sea of East China and the Yellow Sea.

5. Squid fishing grounds around the Islands of Japan.

6. Salmon fishing grounds south of 48° in the western Pacific Ocean.

II. Organization

The program consists of the following two major parts:

1. To prepare the forecasting.

2. To disseminate the forecasting.

The former is implemented by the National and Prefectural Fisheries Research Laboratories and Experimental Stations while the latter is implemented by the "All Japanese Federation of the Fisheries Associations" ("Zen-gyo-ren").

III. The types of forecasts:

(a) Speedy information of the present fishing and oceanic patterns with their predictions within short period (several days) including the fish market conditions at major ports in each area as far as possible (issued weekly or at least every ten days.

Prefectural (Local) Fisheries Experimental Stations take charge of it. (Telex and mail used.)

(b) Medium-term forecast (issued regularly more than twice a month during each fishing season in broader sea-district). 6 Regional Fisheries Research Laboratories with 34 Prefectural Fisheries Experimental Stations take charge of it (telex and mail).

(c) Long-term forecast of fisheries (issued more than once before or within each fishing season).

Prepared by the responsible Regional Fisheries Research Laboratories after the discussion of Forecasting Meetings participated in by the Laboratories and Experimental Stations concerned. Contents: Prospects of oceanic and fishing patterns - fishing localities, beginning and end of fishing periods, fish abundance, age or size composition, fluctuations of population size and distribution pattern, long-term trends, etc.

General reports of fishing and oceanic patterns (Feb., April, June, Aug., Oct., Dec.) are printed and disseminated regularly by Regional Fisheries Research Laboratories.

(d) At the end of every fiscal year annual report and next year program (plan) are presented from all agencies concerned with the Director of the Fisheries Agency. All Japan Fisheries Oceanographical Forecast Promoting Meeting is held once a year. Aereal Survey (using aircraft) is conducted by three Regional Fisheries Research Laboratories in addition to ship survey.

IV. The dissemination of forecasts:

"Zen-gyo-ren" (AJFSA) collect the above information from both national and prefectural laboratories and experimental stations by means of telex, telephones, etc. and edits the draft of synthetic forecasting of all Japan for broadcasts from radio broadcasting stations (NHK, NSB) and Facsimile Broadcasting Station (Jiji Tsushin) in contact.

Daily programs - broadcasts, 10 minutes every day (except Sunday and holidays) for radio. Broadcasts, 2 hours for facsimile (for radio). Special meetings and publications are planned to improve the understanding and cooperation of fishermen.

APPENDIX III

FISH SCOUTING SERVICE

The fishing industry of the USSR employs a Fish Scouting Service covering the Pacific, Atlantic and Indian Oceans and the Bering Sea.

The Service has two objectives; direct fish detection in the fishing area and the prospecting services whose aim is to provide estimates of the fish stock in a particular area and to some degree forecast the state of the stock so as to permit planning for their effective utilization.

The Fish Scouting Service is coordinated and directed by VNIRO, and the corresponding branch of coastal institutes are in charge of operations.

Both parts of the Service are based on the biological and environmental studies of the main species of the fisheries. Comprehensive investigation including geology, hydrochemistry, hydrobiology (plankton, benthos), ichthyology, and technological research are therefore carried out.

The programs of the Scouting Service in each region are similar, with only slight variations.

Many research vessels, some of them as large as 3,800 ton, and smaller scouting boats are engaged in the program. Both types of vessels are equipped with fish detection devices and with experimental fishing gear. Many ships have on-board laboratories for the necessary hydrochemical analysis (determination of salinity, oxygen, biogenetic elements) as well as facilities for preliminary processing of plankton and benthos, and biological analyses of fish, thus allowing the determination of those factors which influence fish concentrations, their movements and distribution.

Oceanographic data, such as temperature and salinity, and data on the concentration of fish schools, are transmitted by wireless to the Fish Scouting Service B oard in VNIRO, where synoptic maps of the environmental conditions and the concentration of fish schools in a particular area, are normally drawn every ten days, although for some special regions they are drawn daily. Short term forecasting of conditions is also made.

The information is disseminated by radio; facsimile is not used at present.

The prospecting fish scouting service also helps to issue long term forecasts for the fishing industry of the USSR on the basis of studies of the structure of commercial fish populations.

MR/65760/10.67/E/1/1230